PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of

Motohide TAKEICHI et al.

Application No.: 10/633,614 Examiner: V. CHANG

Filed: August 5, 2003 Docket No.: 106973.01

For: ADHESIVE MATERIAL AND CIRCUIT CONNECTION METHOD

BRIEF ON APPEAL

Appeal from Group 1771

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I. REAL PARTY IN INTEREST

The real party in interest for this appeal and the present application is Sony Chemical and Information Device Corporation, by way of an Assignment recorded in the U.S. Patent and Trademark Office at Reel 0185501, Frame 0258.

II. RELATED APPEALS AND INTERFERENCES

A Notice of Appeal was filed in this application on May 1, 2007. There are no other prior or pending appeals, interferences or judicial proceedings known to Appellant, Appellant's representative, or the Assignee, that may be related to, or that will directly affect or be directly affected by or have a bearing upon, the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1 and 6 are on appeal.

Claims 1 and 6 are pending.

Claims 1 and 6 are rejected.

Claims 2-5 and 7 are canceled.

IV. STATUS OF AMENDMENTS

An Amendment After Final Rejection was filed on March 28, 2006. By an Advisory Action dated April 5, 2006, it was indicated that the requested amendments had not been entered. A Request for Continued Examination and Amendment were filed on September 18, 2006. A second Final Rejection issued November 2, 2006. No subsequent Amendment After Final Rejection has been filed.

V. SUMMARY OF CLAIMED SUBJECT MATTER

A summary of the subject matter of the independent claims is given below with reference to the specification and drawings. Any reference to the specification and drawings below is only exemplary and should neither be construed to encompass every portion of the specification and drawings that supports the various claim features nor construed to limit the claimed subject matter beyond the claim language.

Historically, integrated circuit packages having semiconductor elements mounted on packaging substrates, such as circuit boards or mother boards, have been implemented in portable electronic devices, such as cellular telephones (P1/L10-14). In such devices, the packaging substrates have a relatively larger surface area than the semiconductor element being mounted (P1/L10-14).

Recently, however, more compact electronic devices with increased functionality have been sought (P1/L14-17). Conventional solutions to the larger and less functional integrated circuit designs have included the design and implementation of flip-chip mounting the semiconductor on the substrate in a bare-chip state, and the use of chip size packages (CSP) that are mounted on the substrate (P1/L18-24). Each substrate in these conventional solutions is approximately the same size as the semiconductor element, as opposed to the larger substrate associated with integrated circuit package designs (P1/L21-24). Typically, an insulating adhesive or an anisotropically conductive adhesive, in which conductive particles are dispersed, is used to adhere the bare chip or CSP to the terminal electrode of the motherboard or substrate. The insulating adhesive may take the form of a liquid, paste or film, and the anisotropically conductive adhesive may take the form of a paste or film (P1/L24-25; P2/L1-4). However, electrodes frequently separate or peel away from the substrate at the regions in which the adhesive is applied due to the difference in thermal expansion coefficient between the substrate and the bare chip or CSP. Additionally,

variations in the heights of electrodes often leads to variations in the distances between the motherboard connecting terminals. Such peeling away and variations in the height of electrodes often results in increased conductivity resistance, poor connectivity and various resultant reliability problems (P2/L10-21).

Artisans have attempted to solve the foregoing problems associated with peeling away and variations in the height of electrodes by compounding with the insulating adhesive or anisotropically conductive adhesive an inorganic filler having a mean particle size of 3 microns or less at a ratio of 5 to 200 weight parts per 100 weight parts adhesive (P2/L22-25; P3/L1-6). See, for example, Japanese Patent Application Laid-Open No. (HEI) 11-061088). Nonetheless, these attempts have not sufficiently addressed the foregoing problems.

The invention of claim 1 is thus directed to an anisotropic conductive adhesive material for connecting an electrode of a semiconductor, or the like, to a terminal electrode of a circuit board (e.g., a mother board) that contains at least one curable resin and inorganic particles (Fig. 1). The Applicants have discovered that specifying the mean particle size, and compounding with the adhesive an appropriate amount of inorganic particles, is effective when additionally limiting the surface area of the inorganic particles to within a prescribed range, and establishing the maximum particle size at one half or less of the sum of the height of the electrode of the electronic component and the height of the electrode of the circuit board (P3/L21-25; P4/L1-9). Specifically, the claimed anisotropic conductive adhesive material comprises at least one curable resin and silica particles, wherein:

the silica particles have a specific surface area S (m^2/g) satisfying Equation (1) below;

$$11 < S \leq 17 \quad (1);$$

the silica particles have a mean particle size D_1 (μm) and maximum particle size D_2 (μm) satisfying Equations (2) and (3) below, respectively,

$$D_1 \leq 5 \quad (2);$$

$$D_2 \leq 0.5\,(h_1 + h_2) \qquad (3);$$

wherein h_1 represents the height of the protuberant electrode in the electronic component, and h_2 represents the height of the terminal electrode in the circuit board, the content of the silica particles is 35 to 60 vol%, and the mean particle size D_1 of the silica particles further satisfies the Equation (4) below,

$$0.1(h_1 + h_2) \geq D_1 \qquad (4);$$

wherein the anisotropic conductive adhesive material further comprises conductive particles having a mean particle size of 0.5 to 8.0 μm; and

wherein the anisotropic conductive adhesive material has a coefficient of moisture absorption in a 85% RH, 85°C atmosphere is 1.5 wt % or less. See claim 1.

In an embodiment, the invention of claim 1 is further limited such that electronic component is a semiconductor element.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The following grounds of rejection are presented for review:

Claims 1 and 6 are rejected under 35 U.S.C. §103(a) as having been obvious over U.S. Patent No. 6,083,774 to Shiobara et al. ("Shiobara '774") in view of U.S. Patent No. 6,001,901 to Shiobara et al. ("Shiobara '901").

VII. ARGUMENT

The Examiner rejects claims 1 and 6 as having been obvious under 35 U.S.C. §103(a) over Shiobara '774 in view of Shiobara '901.

In the rejection, the Examiner has consistently improperly applied the law relating to obviousness, and has failed to establish a *prima facie* case of unpatentability. Proper application of the law and consideration of the cited references demonstrates that no *prima facie* case of obviousness has been established.

A. None of the Pending Claims Would Have Been Obvious Under 35 U.S.C. §103(a) Over Shiobara '774 in View of Shiobara '901

1. Factual Inquiries to Determine Obviousness / Non-Obviousness

Several basic factual inquiries must be made in order to determine obviousness or non-obviousness of the claims of a patent application under 35 U.S.C. §103(a). These factual inquiries include considering the scope and content of the prior art, the differences between the prior art and the claims at issue, the level of ordinary skill in the art, and any secondary considerations that may be present. Graham v. John Deere Co., 383 U.S. 1, 17, 148 USPQ 459, 467 (1966).

2. Claims 1 and 6 Would Not Have Been Obvious Under 35 U.S.C. §103(a) Over Shiobara '774 in View of Shiobara '901.

Instant independent claim 1 recites:

> An anisotropic conductive adhesive material, for connecting a protuberant electrode of an electronic component to a terminal electrode of a circuit board for carrying the electronic component, the anisotropic conductive adhesive material comprising at least one curable resin and silica particles, wherein:

the silica particles have a specific surface area S (m^2/g) satisfying Equation (1) below;

$$11 < S \leq 17 \quad (1);$$

the silica particles have a mean particle size D_1 (μm) and maximum particle size D_2 (μm) satisfying Equations (2) and (3) below, respectively,

$$D_1 \leq 5 \quad (2);$$

$$D_2 \leq 0.5\,(h_1 + h_2) \quad (3);$$

wherein h_1 represents the height of the protuberant electrode in the electronic component, and h_2 represents the height of the terminal electrode in the circuit board,

the content of the silica particles is 35 to 60 vol%, and

the mean particle size D_1 of the silica particles further satisfies the Equation (4) below,

$$0.1(h_1 + h_2) \geq D_1 \quad (4);$$

wherein the anisotropic conductive adhesive material further comprises conductive particles having a mean particle size of 0.5 to 8.0 μm; and

wherein the anisotropic conductive adhesive material has a coefficient of moisture absorption in a 85% RH, 85°C atmosphere is 1.5 wt % or less.

As described above, instant independent claim 1 is thus directed to an anisotropic conductive adhesive material that contains at least one curable resin and inorganic particles, and that requires the surface area of the inorganic particles to fall within a prescribed range,

and establishes the maximum particle size at one half or less of the sum of the height of the electrode of the electronic component and the height of the electrode of the circuit board.

In particular, instant claim 1 requires the silica particles to have a specific surface area between 11 and 17 m^2/g in an amount of 35 to 60 percent volume. Instant claim 1 also requires conductive particles to have a mean particle size of 0.5 to 8.0 μm. Because such conductive particles are much smaller than the electrodes that are being connected, most of the surface area of the electrodes are in contact with molding resin. Hence, by providing a molding resin having the claimed coefficient of moisture absorption in a 85% relative humidity, 85°C atmosphere of 1.5 wt % or less, it is possible to avoid moisture penetration between, for example, a substrate and a semiconductor, or the like. See Specification, page 10, lines 12-20. Due to its dependency, claim 6 also includes such limitations.

a. Shiobara '774 Does Not Teach or Suggest The Claimed Invention

Shiobara '774 discloses an adhesive composition including a resin, an inorganic filler and curing agent, the inorganic filler having a specific surface area of 3.5 to 6.0 m^2/g. See Shiobara '774 at col. 7, line 8. Shiobara '774 also discloses that the particle size of the organic filler can be up to 24μm, and can be present in an amount of 100 to 550 parts by weight per 100 parts by weight of the epoxy resin, or 50 percent to 85% by weight of the entire composition. See Shiobara '774 at abstract; col. 6, lines 62-64 and col. 7 lines 46 and 47..

However, Shiobara '774 fails to disclose a specific surface area of its inorganic filler as from 11 to 17 m^2/g; fails to teach or suggest an anisotropic conductive adhesive material having the claimed coefficient of moisture absorption that, in a 85% relative humidity, 85°C atmosphere, is 1.5 wt % or less; and fails to teach or suggest employing inorganic fillers in the amount of 35 to 60 percent by volume.

At least because Shiobara '774 fails to disclose the foregoing features of instant claim 1, from which claim 6 depends, Shiobara '774 fails to present a *prima facie* basis for an obviousness rejection.

(1) Shiobara '774 Does Not Disclose the Claimed Specific Surface Area of the Silica Particles

Shiobara '774 does not disclose a specific surface area of its inorganic filler as from 11 to 17 m^2/g. The Examiner concedes this point in the Final Rejection, mailed November 2, 2006. In fact, Shiobara '774 specifically discloses the particle size of its inorganic filler as from 3.5 m^2/g to 6 m^2/g. See Shiobara '774 at col. 7, line 8.

The claimed range of from 11 to 17 m^2/g is critical insofar as when the surface area of the inorganic particles is too small, damage may occur to the protective film on the connecting side of the electronic component. See specification at, for example, page 7, lines 7-11. When the surface area of the inorganic particles exceeds 17 m^2/g, the adhesive material does not properly flow and thus requires extreme pressure in order to form the connection. See specification at, for example, page 7, lines 11-18. Further, when the surface area of the inorganic particles exceeds 17 m^2/g, the bonding workability of the adhesive decreases, thus creating difficulties in eliminating the negative effects caused by variations in the distance between the electrodes on the semiconductor, or the like, and the terminal electrodes of the substrate. See Id.

At least because Shiobara '774 fails to disclose this feature of the claims, it fails to present a *prima facie* basis for an obviousness rejection.

(2) Shiobara '774 Does Not Disclose the Required Coefficient of Moisture Absorption

A separate patentable feature of the claimed invention is the 1.5 weight percent or less coefficient of moisture absorption in a 85% relative humidity, 85°C atmosphere. By providing a molding resin having a coefficient of moisture absorption in a 85% relative

humidity, 85°C atmosphere of 1.5 wt % or less, as claimed, it is possible to avoid moisture penetration between, for example, a substrate and a semiconductor, or the like. See specification, page 10, lines 12-20.

Shiobara '774 nowhere discloses such a feature, nor would it have been obvious to have modified Shiobara '774 to incorporate this feature, at least because Shiobara '774 is silent on the problems caused by moisture penetration between the electrodes. Shiobara '774 merely discloses an encapsulant that is introduced under pressure in the molten state to the space between a chip and substrate, and then heat cured. Nowhere does Shiobara teach or suggest the need to specify any coefficient of moisture absorption. Thus, there is no motivation or suggestion in Shiobara '774 to have incorporated a 1.5 weight percent or less coefficient of moisture absorption in a 85% relative humidity, 85°C atmosphere.

At least because Shiobara '774 fails to disclose this feature of the claims, it fails to present a *prima facie* basis for an obviousness rejection.

(3) Shiobara '774 Does Not Disclose the Required Percent by Volume of Filler

Instant claim 1 requires that the content of the silica particles be from 35 to 60 percent volume of the adhesive. Shiobara '774 discloses an amount of inorganic filler as 50 to 85 percent by *weight* of the adhesive composition. See Shiobara '774 at col. 7, line 47. Thus, nowhere does Shiobara '774 disclose this claimed feature. Nonetheless, the Examiner asserts that, although the prior art is silent with respect to the percent volume of the filler, the claimed range is considered to be an obvious optimization to an ordinarily skilled artisan in order to provide the required heat conductivity and flow viscosity. However, the Examiner fails to substantiate this aspect of the rejection with the required specificity and the Examiner nowhere cites the advantage of increased reliability imparted by the claimed percent volume of filler. See page 8, lines 14-21.

At least because Shiobara '774 fails to disclose this feature of the claims, it fails to present a *prima facie* basis for an obviousness rejection.

b. Shiobara '901 Does Not Remedy The Deficiencies Of Shiobara '774

As discussed above, Shiobara '774 does not teach or suggest every feature of instant claim 1, or claim 6 depending therefrom. Moreover, Shiobara '901 fails to remedy the deficiencies of Shiobara '774.

The Examiner concedes that volume percent of filler and coefficient of moisture absorption are not recited in Shiobara '901. The Examiner asserts only that these features would be routine optimization in the art. Thus, Shiobara '901 appears only to be cited for merely disclosing an ultrafine silica having a specific surface area of 5 to 40 m^2/g. Accordingly, the Examiner thus asserts that it would have been obvious to incorporate a suitable percent volume of the filler disclosed in Shiobara '901 into the adhesive disclosed in Shiobara '774.

Applicants respectfully reject each of the Examiner's assertions. As discussed above, by providing a molding resin having a coefficient of moisture absorption in a 85% relative humidity, 85°C atmosphere of 1.5 wt % or less, as claimed, it is possible to avoid moisture penetration between, for example, a substrate and a semiconductor, or the like. See Specification, page 10, lines 12-20. In contrast, Shiobara '901 only addresses moisture absorption by disclosing that an encapsulant is introduced under pressure to the space between a chip and substrate, and then heat cured. The Examiner has merely asserted that the claimed coefficient of moisture absorption would be routine optimization in the art. However, the Examiner has not proffered any evidence that either reference, or the art itself, recognizes the claimed coefficient of moisture absorption as a result-effective variable. Because such evidence has not been proffered, the Examiner has not met his burden of

establishing that it would have been obvious to an ordinarily skilled artisan to have optimized this range through routine experimentation.. See MPEP 2144.05. Thus, nowhere does Shiobara '901 teach or suggest the specific claimed coefficient of moisture absorption, or the advantages thereof.

The Examiner also concedes that Shiobara '901 is additionally silent with respect to the percent volume of the filler. However, Applicants submit that at least because the Examiner fails to appreciate the advantage of increased reliability imparted by the claimed percent volume of filler, such a feature cannot be said to be a simple routine optimization in the art.

Finally, the claimed range for silica particle surface area of 11 to 17 m^2/g is neither taught nor suggested in the references themselves, nor would it have been an obvious modification of Shiobara '774 based on knowledge in the art. The claimed range for silica particle surface area of 11 to 17 m^2/g is critical insofar as when the surface area of the inorganic particles is too small, damage may occur to the protective film on the connecting side of the electronic component. When the surface area of the inorganic particles exceeds 17 m^2/g, the adhesive material does not properly flow and thus requires extreme pressure in order to form the connection. Further, when the surface area of the inorganic particles exceeds 17 m^2/g, the bonding workability of the adhesive decreases, thus creating difficulties in eliminating the negative effects caused by variations in the distance between the electrodes on the semiconductor, or the like, and the terminal electrodes of the substrate.

Nowhere does Shiobara '901 discuss the importance of the foregoing advantages imparted by the critical range for silica particle surface area that is claimed. Rather, Shiobara '901 appears to disclose a surface area range of 5 to 40 m^2/g in order to address issues relating to viscosity and closeness of packing of the filler. Moreover, the claimed range spans only 6 m^2/g, which is only approximately 17 percent of the range of 5 to 40 m^2/g disclosed in

Shiobara '901. Hence, reading the overly broad range of silica particle surface area disclosed in Shiobara '901 would cause an ordinarily skilled artisan to undergo undue experimentation before a suitable filler surface area was achieved.

Thus, it would not have been obvious, nor is there any suggestion or motivation to have combined the range for surface area of the silica particle disclosed in Shiobara '901 into the Shiobara '774, in order to obtain the claimed surface area range, at least because the rationale for doing so is absent in the references, and there would only be a slight chance of success if experimentation was undertaken.

Neither Shiobara '901 nor Shiobara '774 teaches or suggests the features of claim 1 or dependent claim 6. Thus, even if Shiobara '774 and Shiobara '901 were combined, the combination would not have resulted in the product of claim 1 or claim 6 depending therefrom.

c. The Combination of Shiobara '774 and Shiobara '901 Would Not Have Rendered Obvious Claims 1 and 6

As discussed above, Shiobara '774 and Shiobara '901 do not disclose every feature of instant claim 1, or claim 6 depending therefrom. The Examiner concedes that volume percent of filler and coefficient of moisture absorption are not recited in the references, and thus merely asserts that such features would be routine optimization in the art. Shiobara '774 also clearly does not disclose the critical claimed surface area of silica particles of from 11 to 17 m^2/g, and Shiobara '901 appears only to be cited for disclosing silica having a surface area of 5 to 40 m^2/g. As described above, the disclosure in Shiobara '901 nowhere appreciates the important advantages imparted by the critical range for silica particle surface area that is claimed, and appears to disclose its broad surface area range of 5 to 40 m^2/g in order only to address issues relating to viscosity and closeness of packing of the filler. Accordingly, the range disclosed in Shiobara '901 is overly broad due to its suitability for a different purpose

than the claimed range, and would cause an ordinarily skilled artisan to undergo undue experimentation before a suitable filler surface area was achieved.

Shiobara '901 thus also fails to remedy the deficiencies of Shiobara '774, and neither reference teaches or suggests the features of claim 1. Thus, even if Shiobara '774 and Shiobara '901 were combined, the combination would not have resulted in the product of claim 1 or claim 6 depending therefrom.

d. Conclusion

Applicants respectfully submit that, for at least the reasons set forth above, Shiobara '774 and Shiobara '901, individually and in combination, cannot support the rejection of claims 1 and 6.

VIII. CONCLUSION

For all of the reasons discussed above, it is respectfully submitted that the rejection is in error and that claims 1 and 6 are in condition for allowance. For all of the above reasons, Appellants respectfully request this Honorable Board to reverse the rejection of claims 1 and 6.

Respectfully submitted,

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APPENDIX A - CLAIMS APPENDIX

CLAIMS INVOLVED IN THE APPEAL:

1. An anisotropic conductive adhesive material, for connecting a protuberant electrode of an electronic component to a terminal electrode of a circuit board for carrying the electronic component, the anisotropic conductive adhesive material comprising at least one curable resin and silica particles, wherein:

the silica particles have a specific surface area S (m^2/g) satisfying Equation (1) below;

$$11 < S \leq 17 \qquad (1);$$

the silica particles have a mean particle size D_1 (μm) and maximum particle size D_2 (μm) satisfying Equations (2) and (3) below, respectively,

$$D_1 \leq 5 \qquad (2);$$

$$D_2 \leq 0.5\ (h_1 + h_2) \qquad (3);$$

wherein h_1 represents the height of the protuberant electrode in the electronic component, and h_2 represents the height of the terminal electrode in the circuit board,

the content of the silica particles is 35 to 60 vol%, and

the mean particle size D_1 of the silica particles further satisfies the Equation (4) below,

$$0.1(h_1 + h_2) \geq D_1 \qquad (4);$$

wherein the anisotropic conductive adhesive material further comprises conductive particles having a mean particle size of 0.5 to 8.0 μm; and

wherein the anisotropic conductive adhesive material has a coefficient of moisture absorption in a 85% RH, 85°C atmosphere is 1.5 wt % or less.

6. The adhesive material according to Claim 1, wherein the electronic component is a semiconductor element.

APPENDIX B - EVIDENCE APPENDIX

NONE

APPENDIX C - RELATED PROCEEDINGS APPENDIX

NONE